NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

TERRACE

(ft, m)

CODE 600

*Indicates a North Dakota Supplement

DEFINITION

An earth embankment, a channel, or a combination ridge and channel constructed across the slope.

SCOPE

This standard applies to the planning and design of all types of terraces. It does not apply to diversions.

PURPOSE

To: (1) reduce slope length, (2) reduce erosion, (3) reduce sediment content in runoff water, (4) improve water quality, (5) intercept and conduct surface runoff at a nonerosive velocity to a stable outlet, (6) retain runoff for moisture conservation, (7) prevent gully development, (8) reform the land surface, (9) improve farmability, or (10) reduce flooding.

* CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

1. Water erosion is a problem.
2. There is a need to conserve water.
3. The soils and topography are such that terraces can be constructed and farmed with reasonable effort.
4. A suitable outlet can be provided, or
5. Runoff and sediment can damage land or improvements downstream or impair water quality.

* DESIGN CRITERIA

* **Spacing.** The maximum spacing for terraces for erosion control shall be determined by one of the following methods:

1. $V.I. = xs + y$ or $H.I. = (xs + y)\ (100/s)$

Where:

V.I. = vertical interval in ft(m)

H.I. = horizontal interval in ft.(m) (see figures 1 and 2)

x = a variable with values from 0.4 to 0.8 (0.12 to 0.24)

s = land slope in percent

y = a variable with values from 1.0 to 4.0 (0.3 to 1.2)

Values of *x* for different geographical zones are shown in figure 4. Values of *y* are influenced by soil erodibility, cropping system, and crop management practices. A value of 1.0 (0.3) shall be selected for erodible soils with tillage systems that provide little or no cover during periods of intense rainfall. A value of 4.0 (1.2) shall be used for erosion-resistant soils with tillage systems that leave a large amount of cover (1.5 tons of straw equivalent per acre or 3.4 metric tons per hectare) on the surface. A value of 2.5 (0.75) shall be used if one of the factors indicated is favorable and the other unfavorable. Other values between 1.0 (0.3) and 4.0 (1.2) may be used according to the estimated quality of the factors. The horizontal spacing does not have to be less than 90 ft.

2. Universal soil less equation (USLE). The spacing shall not exceed the slope length determined by using the allowable soil loss, the most intensive use planned, the expected level of management, and terrace P factor (table 1).

In no case shall the maximum horizontal spacing exceed that shown in table 2 for the conditions shown. The maximum limits may not be exceeded when making the adjustments indicated below. Spacing may be increased as much as 10 percent to provide better alignment or location, to adjust for farm machinery, or to reach a satisfactory outlet. Spacing may be increased an additional 10 percent for terraces

with underground outlets. The spacing shall be adjusted to provide for an even number of trips for anticipated row crop equipment and maximum opportunity for changing row widths. The likelihood of benching of steep slopes by tillage, land forming, and erosion shall be considered when determining the terrace interval.

For level terraces used for erosion control and water conservation, the spacing shall be determined as indicated earlier, but the maximum horizontal spacing shall not exceed 600 ft (180 m). An *x* value of 0.8 (0.24) may be used for all level terraces used primarily to impound water. Figures 1 and 2 show the horizontal interval or erosion length to be used in calculating terrace spacing (figure 3).

For terraces on noncropland, the maximum spacing shall be governed by the capacity requirement.

Table 1.- Terrace P factors

Horizontal Interval		Closed Outlets[1]	Open outlets, with percent grade of [2]		
(ft)	*(m)*		0.1 - 0.3	0.4 - 0.7	0.8
Less than 110	Less than 33	0.5	0.6	0.7	1.0
110 - 140	33 - 42	0.6	0.7	0.8	1.0
1.0	43 - 54	0.7	0.8	0.9	1.0
180 - 225	55 - 68	0.8	0.8	0.9	1.0
225 - 300	68 - 90	0.9	0.9	1.0	1.0
More than 300	More than 90	1.0	1.0	1.0	1.0

NOTE: If contouring or stripcropping P factors are appropriate, they can be multiplied by the terrace P factor for the composite P factor.

[1] "P" factors for closed outlet terraces also apply to terraces with underground outlets and to level terraces with open outlets.
[2] The channel grade is measured on the 300 ft of terrace or the one-third of total terrace length closest to the outlet, whichever distance is less.

Table 2.- Maximum horizontal spacing for terraces

Slope	USLE R factor of									
	0 - 35		35 - 175		More than 175		With contour stripcropping		For concentrated flow control	
Percent	ft	m	ft	m	ft	m	ft	m	ft	m
0 - 2	700	210	500	150	450	130	600	180	700	210
2 - 4	700	210	400	120	300	90	600	180	700	210
4 - 6	600	180	400	120	200	60	600	180	600	180
6 - 9	400	120	300	90	150	45	400	120	500	150
9 - 16	400	120	250	75	150	45	250	75	500	150
12 - 18	250	75	200	60	150	45	150	45	400	120
More than 18	250	75	200	60	150	45	150	45	300	90
Minimum spacing required, all slopes	200	60	150	45	90	27	90	27	200	60

Alignment. Terraces shall be parallel if feasible and as parallel as practicable. Curves shall be long and gentle to accommodate farm machinery. Land forming, extra cut fill along the terrace line, multiple outlets, variations in grade, channel blocks, and other methods shall be used to achieve good alignment.

Field efficiency may be used to compare alternative terrace systems. Field efficiency is the ratio of time required to farm the field being planned, to that required to farm a rectangular field of the same acreage ½ mi. long.

Capacity. The terrace shall have enough capacity to control the runoff from a 10-year frequency, 24-hour storm without overtopping. For terraces with underground outlets, the capacity shall be increased by the estimated 10-year sediment accumulation, unless provisions are made to maintain the design capacity through maintenance. Terrace systems designed to

provide flood protection or to function with other structures shall have adequate capacity to control a storm of a frequency consistent with the potential hazard. When the capacity is determined by the formula Q = AV and the V is calculated by using Manning's formula, an n value of 0.06 shall be used for bare channels; and SCS-TP-61, Handbook of Channel Design for Soil and Water Conservation, or equivalent, shall be used for vegetated channels.

***Cross section.** The terrace cross section shall be proportioned to fit the land slope, the crops grown, and the farm machinery used. Additional height shall be added if necessary to provide for settlement, channel sediment deposits, ridge erosion, the effect of normal tillage operations, and safety. The ridge shall have a minimum width of 3 ft. (1 m) at the design elevation.

The minimum slope of a vegetated front or back ridge slope is 2:1. If necessary, steeper slopes may be used for special purposes but must be stable. The opening at the outlet end of gradient and open-end level terraces shall have a cross section equal to that specified for the terrace channel.

End closures. Level terraces may have open ends, partial end closures, or complete end closures. Partial and complete end closures shall be used only on soils and slopes where the stored water will be absorbed by the soil without appreciable crop damage or where underground outlets are provided.

Figure 1

Horizontal Interval for Steep Back-Slope Terraces

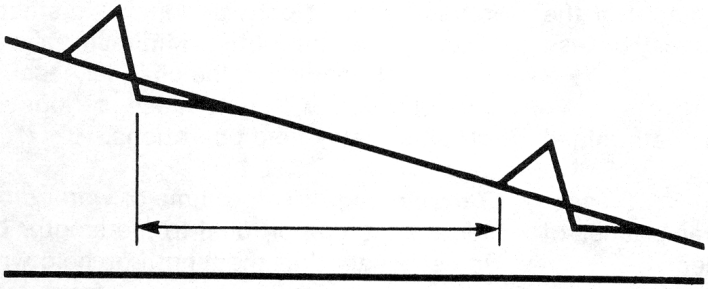


Figure 2

Horizontal Interval for Broad-Based Terraces

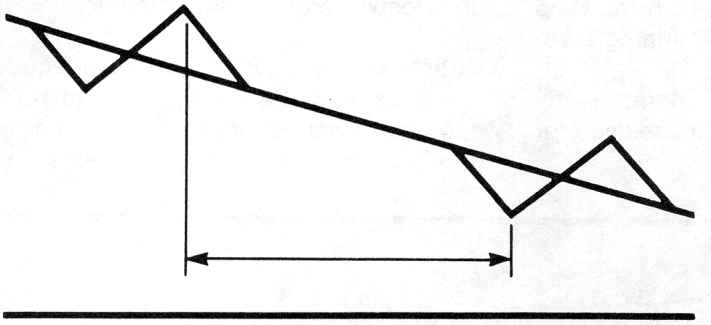
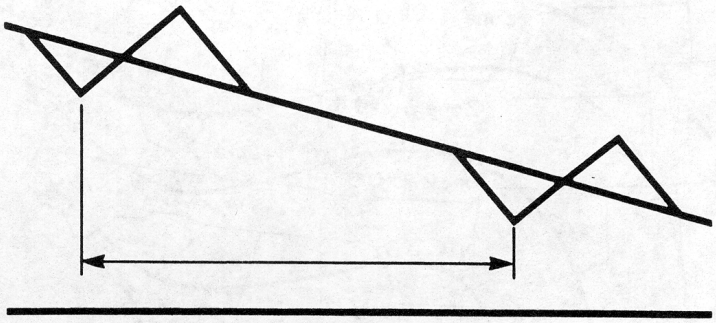


Figure 3

Terrace Spacing



If terraces with closed or partly closed ends are specified, the end closures must be installed before the terraces are completed. The end closures shall be designed so that the water flows over the end closure before overtopping the terrace ridge.

Partial end closures shall not be more than half the effective height of the terrace ridge. Complete end closures are more than half the height of the ridge. The cross section of the closures may be less than the terrace cross section.

***Channel grade.** Channel grade shall be determined by one of the following methods:

1. Maximum channel grade in the lower reaches of the channel shall not exceed 0.6 percent.
2. Maximum channel velocity for farmed channels shall be nonerosive for the soil and planned treatment. Maximum velocity for erosion-resistant soils is 2.5 ft/s (0.75 m/s); for average soils, 2.0 ft/s (0.6 m/s); and for easily erodible soils, 1.5 ft/s (0.45 m/s). Maximum velocity for Hawaii shall be 5.5 ft/s (1.65 m/s). Velocity shall be computed by Manning's formula, using an n value of 0.035.
3. Maximum channel velocities for permanently vegetated channels shall not exceed those used for grassed waterways. Channel grades may be uniform or variable. Channel velocity shall not exceed that which is non-erosive for the soil and planned treatment. For short distances and in upper reaches, channel grades or velocities may be increased to improve alignment.

If terraces have an underground outlet, water and sediment will pond in the channel, thus reducing the velocity and allowing steeper channel grades near the outlet. Minimum grades shall be such that ponding in the channel grades shall be such that ponding in the channel because of minor irregularities will not cause serious damage to crops or delay field operations.

***Terrace length.** The volume of water stored in level terraces is proportional to the length. Therefore, it is necessary that the length be held within reason so that damage in case of a break is minimized. Level terrace length shall not exceed 3,500 ft (1,000 m) unless the channel is blocked at intervals not exceeding 3,500 ft. (1,000) m). Normally, the gradient terrace length is controlled by the capacity and the nonerosive velocity requirements.

***Outlets.** All terraces must have adequate outlets. Vegetated outlets may be used for gradient or open-end level terraces. Such an outlet may be a grassed waterway or a vegetated area. The outlet must convey runoff water to a point where the outflow will not cause damage.

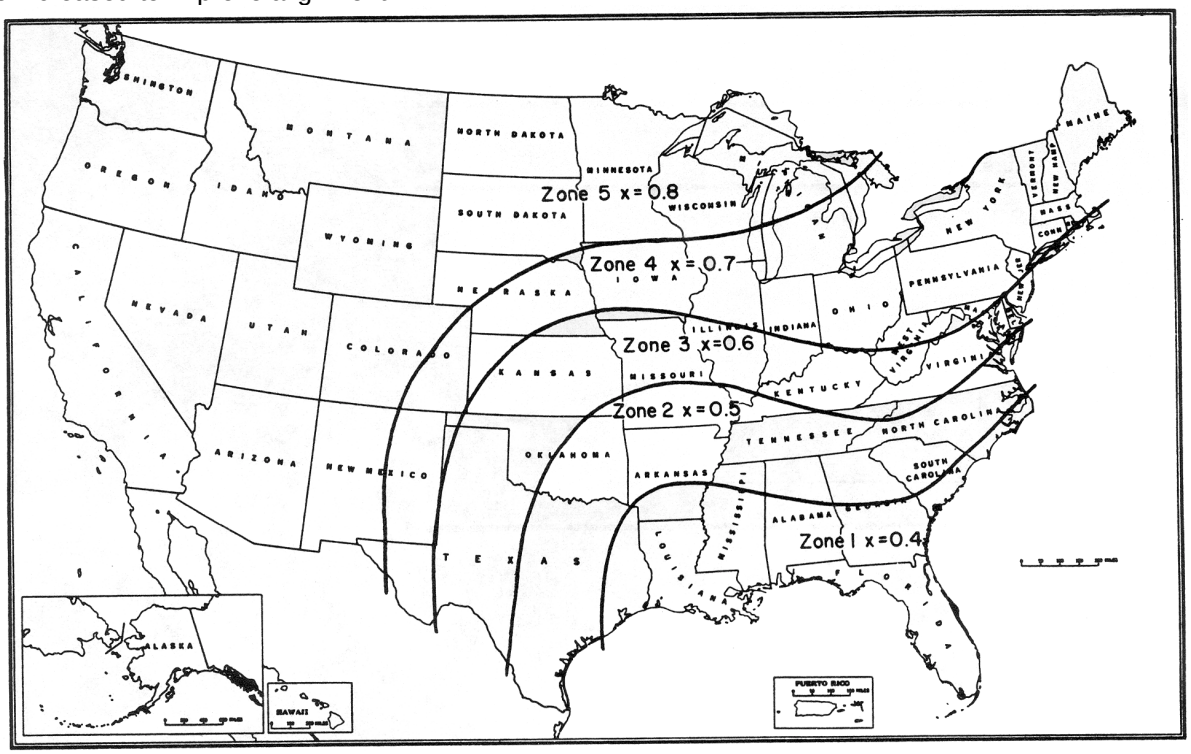


Figure 4 Values of x in equation $V.I. = xs + y$ or $H.I. = (xs+y)\ (100/s)$

Outlets shall be installed and vegetated before the terrace is constructed if necessary to provide a stable nonerodible outlet or to insure establishment of vegetative cover. The water surface in the terrace shall not be lower than the water surface in the outlet at their junction when both are operating at design flow.

Underground outlets may be used on gradient or level terraces. The outlet consists of an intake and an underground conduit. An orifice plate, increase in conduit size, or other features shall be installed as needed to control the release rate and prevent excessive pressure when more than one terrace discharges into the same conduit. The discharge, when combined with the storage, shall be such that a 10-year frequency, 24-hour storm will not overtop the terrace, and growing crops will not be damaged significantly by standing water. The release time shall not exceed 48 hours for the design storm. Shorter periods may be necessary for some crops, depending on soils characteristics and water tolerance of crops to be grown.

The underground conduit shall meet the requirements specified for underground outlets (620) or for subsurface drains (606). Conduits must be installed deep enough to prevent damage from tillage equipment. The inlet shall consist of a vertical perforated pipe of a material suitable for the intended purpose. The inlet shall be located uphill of the front slope of the terrace ridge, if farmed, to permit passage of farm machinery and, if necessary, provide for the anticipated accumulation of sediment and subsequent raising of the terrace ridge. The outlet of the conduit shall have adequate capacity for the design flow without causing erosion. Blind inlets may be used where they are effective, usually in well-rained soils.

Soil infiltration may be used as the outlet for level terraces. Soil infiltration must permit drainage of the design storm from the terrace channel with a reasonable period so that crops are not significantly damaged by standing water.

Combinations of different types of outlets may be used on the same system to maximize water conservation and to provide for economical installation of a more farmable system.

*SAFETY AND MAINTENANCE

A program shall be established for maintaining terrace capacity, storage, ridge height, and outlets. Each inlet for underground outlets must be kept clean and sediment buildup redistributed so that the inlet is in the lowest place. Inlets damaged or cut off by farm machinery must be replaced or repaired immediately.

Terrace ridges, especially those with steep back slopes, can be very hazardous. For this reason, some farmers prefer steep front slopes, thus keeping machinery away from the steep back slopes. All cut and fill slopes that are to be farmed must be no steeper than those on which farm equipment can operated safely. Any hazards must be brought to the attention of the responsible person.

***Vegetation**. All areas to be vegetated shall be established to grass as soon as practicable after construction. The sod shall be maintained and trees and brush controlled by chemical or mechanical means.

*PLANS AND SPECIFICATIONS

Plans and specifications for installing terraces shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

*Terrace Specifications

Construction

All dead furrows, ditches, or gullies shall be filled before constructing the terrace or shall be part of the construction. All old, terraces, fence rows, hedge rows, trees, and other obstructions shall be removed, as necessary, to install a farmable system.

The terraces shall be constructed according to planned alignment, grade and cross section with the specified overfill for settlement and the channel graded to drain reasonably well.

Any ditch or depression at the bottom of the back slope shall be filled and smoothed so that drainage will be away from the terrace and not parallel to it.

Provisions must be made to prevent piping if underground circuits are located under terrace ridges. Mechanical compaction, water packing, trench sidewall sloping, and installation and backfill of conduit trenches early enough to allow adequate settlement are methods that can be used. The materials used for the inlet and the conduit shall be suitable for the purpose intended (see standard 606). Terrace ridges constructed across gullies or depressions shall be compacted by machinery travel or by other suitable means to insure proper functioning of the terrace.

The surface of the finished terrace shall be reasonably smooth and present a workmanlike finish.

If necessary, topsoil shall be stockpiled and spread over excavations and other areas to facilitate restoration of productivity.

If vegetation is required, seedbed preparation, fertilizing, seeding, and mulching shall comply with specifications in technical guides.

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*Conditions Where Practice Applies

Terraces shall be planned and applied as part of the Resource Management System where a combination of practices are used to protect the resource base as outlined in Section III of the North Dakota Technical Guide.

They shall not be constructed on sands or loamy sands that are subject to severe wind erosion or on soils that are too stony or shallow to permit practical and economical installation and maintenance. For cultivated fields, the topography should be such that farmable terraces can be constructed.

Level terraces shall be constructed on soils that are capable of absorbing and storing water without appreciable crop damage, and in semi-arid areas where the rainfall pattern is such that storage of rainfall in the soil, rather than removal, is practicable and desirable. Care should be taken in saline seep areas.

*Design Criteria

Refer to Chapter 8, Engineering Field Manual, for general guidance in terrace planning and design.

*Spacing

The average land slope shall be used to determine the terrace interval.

Terrace spacing should be considered so the farmable area will fit the landowner's present or anticipated future equipment.

The drainage area above the top terrace of a system shall not exceed the area that would be drained by a terrace of equal length with normal spacing.

The maximum spacing shall be determined by the Vertical Interval Method or the Universal Soil Loss Equation (USLE) Method. The narrowest spacing need not be less than 100 feet. If parallel terraces are used, the spacing may be increased to 120 feet.

1. Vertical Interval Method

Vertical spacing as determined by the equation V.I. = 0.8 S + Y in which:

V.I. = Vertical interval in feet

S = Land slope in feet per 100 feet
Y = A variable with values from 1.0 to 4.0

Values of "Y" are influenced by soil erodibility, cropping systems, and crop management practices. A value of 1.0 shall be selected for erodible soils with tillage systems that provide little or no cover during periods of intense rainfall. (Example: <10% ground cover and erodibility factor "K" >0.28.)

A value of 4.0 shall be selected for erosion-resistant soils with tillage systems that leave a large amount of cover. (Example: >80% ground cover and erodibility factor "K" <0.20.)

Other values of "Y" may be taken from the following table:

"Y" VALUES"

	"K" 1/		
Ground Cover 2/	0.0-0.20	0.21-0.27	0.28-0.64
10%	2.5	1.8	1.0
20%	2.7	2.0	1.2
30%	2.9	2.2	1.4
40%	3.1	2.4	1.6
50%	3.4	2.6	1.9
60%	3.6	2.8	2.1
70%	3.8	3.0	2.3
≥80%	4.0	3.3	2.5

1/ "K" values are assigned to each soil series. The K value for a specific soil series can be found in the County Soil Survey Report or SCS Soils Form 5, Soils Interpretation Record, found in Technical Guide Section II-G.

2/ Percent ground cover determination at planting time.

The percent ground cover to be used shall be the average percent cover for a resource management system. The percent ground cover can be determined from the N.D. Recordkeeping and Documentation Guide, Tables 1, 2, and 3.

Horizontal terrace spacing is equal to V.I. divided by Slope X 100, as determined by the equation V.I. = 0.8 S + Y.

Horizontal spacings may be increased or decreased as much as 10 percent to provide better alignment, to miss obstacles in the field, to adjust for width of farm machinery, or to reach a satisfactory outlet. An additional 10 percent increase may be allowed when underground outlets are used.

2. Universal Soil Loss Equation (USLE) Method

SL = A/KRCP, where
L = Slope length factor
S = Slope gradient factor
A = Predicted annual loss in tons per acre per year
K = Soil erodibility factor
R = Rainfall factor
C = Cropping management factor
P = Mechanical erosion control practice factor

The terrace P factors as determined by Table 3 in Section 1-C of the North Dakota Technical Guide, for up and down the slope and contour on various slopes, may be multiplied times the Table 1 terrace P factors in the National Standard. The composite P value is then used in the USLE.

The equation to calculate the horizontal interval (HI) when SL has been determined is:

$$HI = \left(\frac{100\ SL}{0.76 + 0.53\ (S_1) + 0.076\ (S_1)^2} \right)^2$$

S_1 = Land slope in percent.

The spacing shall not exceed the slope length determined by using the USLE Method. Since the USLE may allow for wider terrace spacing on some slopes, maximum horizontal spacing shall be as follows:

Land Slopes	Maximum Horizontal Spacing 1/
0 to 2%	400'
2.1 to 4%	300'
4.1 to 6%	250'
6% & Over	200' or Less

1/ These limits may not be exceeded when making adjustments, as indicated in the Vertical Interval Method.

The maximum horizontal spacing may only be approached when the landowner or user has made a firm decision or a commitment to follow an acceptable resource management system.

*Cross Section

Figures A, B, C, and D provide the minimum cross-sectional dimensions of terraces necessary to fit the land slopes, meet the requirements of the farm machinery, and provide adequate cross-sectional capacity. Slope lengths and channel widths should be adjusted as necessary to fit the width of planned farm equipment.

When terraces are constructed in whole or in part by methods employing longitudinal equipment travel on the embankment (such as a grader or bulldozer), the minimum effective constructed height (h) shall be 1.3 feet. When terraces are constructed by methods employing no equipment travel on the embankment, the minimum effective constructed height (h) shall be 1.6 feet. The effective constructed height (h) is the vertical distance between two points. The bottom point is figured where there is 3.0 feet of bottom width and the top point is figured where there is 3.0 feet of top width for Figures A, B, and C. For flat channel terraces, height (h) is figured from the bottom of the channel to where there is 3.0 feet of top width.

Those terraces that require additional storage capacity above the minimum height shall have 10% overfill if compacted by equipment. If equipment doesn't travel on the fill during construction 20% overfill is required.

Broad Base Terraces - Cross sectional dimensions shall be comparable to those shown in Figure A. With the broad base cross section, excavation for the terrace ridge is generally taken on the uphill side. All portions of the broad base terrace may be farmed; that is, the cutslope, frontslope and backslope. Building a broad base terrace from the uphill side increases the slope of the land. On flat land this can be tolerated. This is not recommended on land with slopes steeper than 8% as the backslope will be so steep as to make farming difficult; it will also increase erosion.

Grassed-Back Terraces - The grassed-back terrace is built where borrow is obtained from below the terrace. All design criteria for farmable terraces except dimensions shall be met. Cross-sectional dimensions shall be comparable to those shown in Figure B. The back slope of the terrace shall be no steeper than 2:1 and shall require the seeding of adapted erosion resistant grass species.

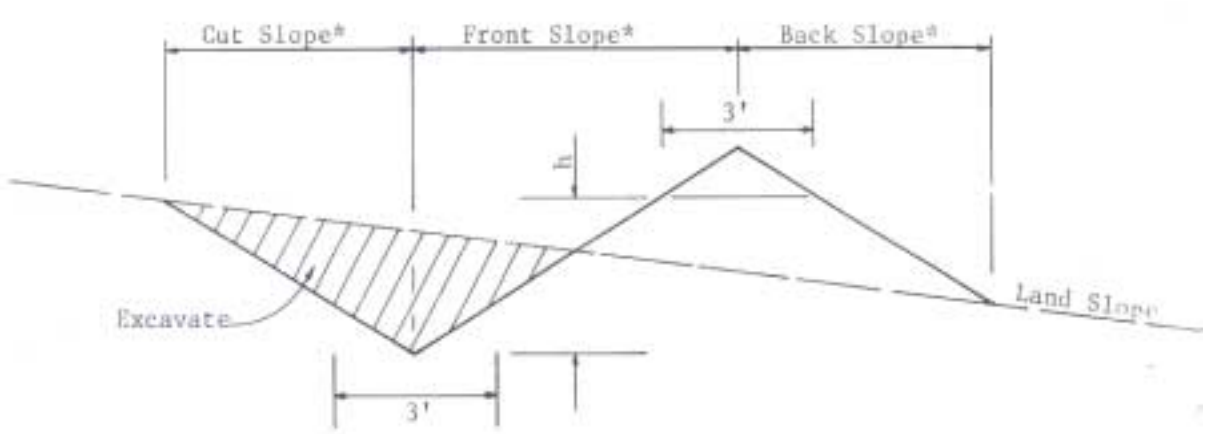
This type of terrace decreases the slope of the land that is farmed. Grassed backslope terraces are recommended for field slopes 8% or greater and where there is an abundance of topsoil, unless provisions are taken for topsoiling. On flatter slopes, they are also well adapted and should be considered for use.

As a matter of safety, the front slope length of grassed-back terraces should be increased approximately 1.5 feet longer than the width of the farm equipment to he used.

Narrow Base Cross Section - Cross-sectional dimensions shall be comparable to those shown in Figure C. With this terrace, both the front slope and the back slope shall be seeded to grass and not farmed. Excavation for this type of terrace should be similar to that recommended for grassed backslope terraces. Some excavation can come from the front slope area. The sum of the front slope and back slope ratios shall be at least 4:1 on land up to 14% and 5:1 on land up to 18% in slope. Neither the front slope or the back slope shall be steeper than 2:1. Narrow base terraces shall not be left loose and uncompacted. Construction equipment shall be used on the terrace during construction to provide compactive effort and to provide a uniform cross section.

Flat Channel Terrace - Cross-sectional dimensions shall be comparable to those shown in Figure D. The main purpose for the flat channel terrace will be for water conservation. The bottom width shall be built in increments based on the landowners equipment or his anticipated equipment size. Care should be taken that the bottom width will not be so large as to be in the subsoil with the cut, unless provisions are taken for topsoiling if needed. The main purpose of the flat channel terrace is water conservation. The flat channel terrace shall be level and be built on soils where the intake rate for the soil shall be such so as to not damage the crops to be grown in the bottom.

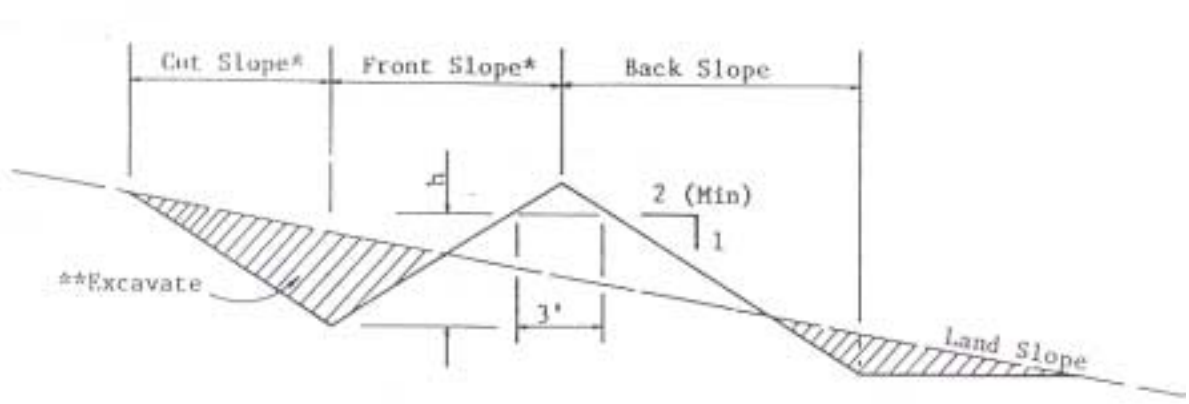
FIGURE A. Minimum Dimensions for Broad Base Terraces



*Length of cut slope, front slope, and back slope shall be farmable but not steeper than 5:1.

h = Design height of terrace.

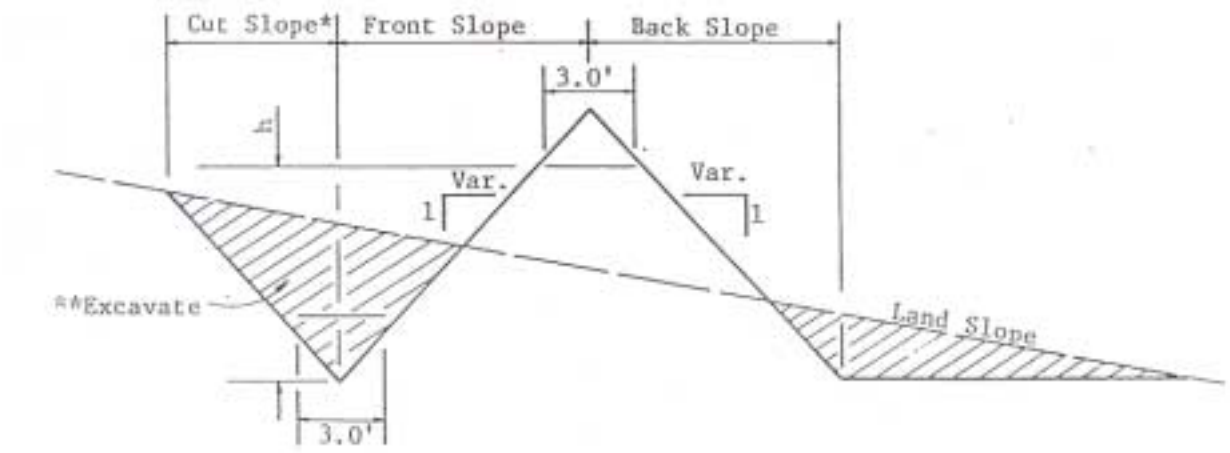
FIGURE B. Minimum Dimensions for Grassed-Back Terraces



*Length of cut slope and front slope shall be farmable but not steeper than 5:1.

h = Design height of terrace.

FIGURE C. Minimum Dimensions for Narrow Base Terraces



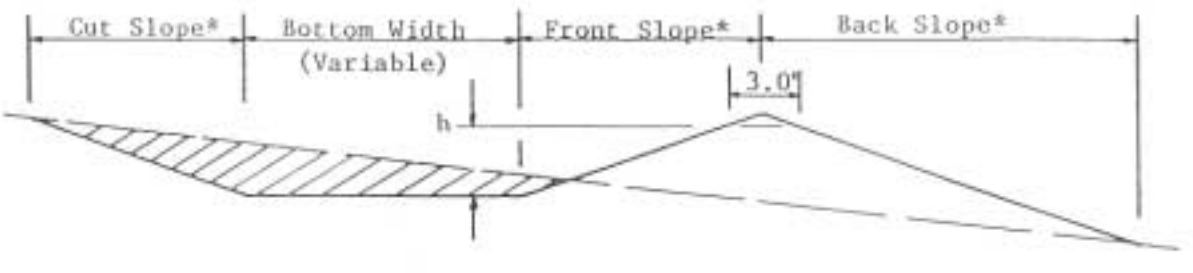
*Length of cut slope shall be farmable but not steeper than 5:1.

The sum of the front slope and back slope ratios shall be at least 4:1 on land up to 14% and 5:1 on land up to 18% slope.

h = Design height of terrace.

**Excavation for Grassed-Back and Narrow Base Terraces should be made from the downhill side of the terrace ridge. Excavate on the uphill side of the terrace ridge only as needed for surface drainage toward outlet.

FIGURE D. Typical Cross Sections for Flat Channel Terraces



*Length of cut slope, front slope and back slope shall be farmable but not steeper than 5:1.

h = Design height of terrace.

*Channel Grade

Channel grade shall be determined by one of the following methods:

1. Maximum channel velocity for farmed channels shall be nonerosive for the soil and planned treatment. Maximum velocity of farmed channels for erosion resistant soils is 2.5 ft/sec (K<O.20), for average soils 2.0 ft/sec (0.2<K<0.28), and for easily erodible soils 1.5 ft/sec (K>O.20). Velocity can be computed by Manning's formula using an n value of 0.035.
2. Channel grade may be either uniform or variable. The overall terrace grade shall not exceed 0.4 percent unless the alignment is significantly improved. A fall of 0.6 foot may be used in the last 200 feet at the outlet end, and the upper 400 feet must have a stable velocity, both of which may be excluded in determining the overall terrace grade. In order to improve alignment and reach a more suitable terrace design, grades may be varied by sections of the terrace.

Gradient terraces shall have 0.1 to 0.2 percent minimum grade unless the allowable velocity is exceeded.

Level terraces shall have level channel grades and ridge tops.

*Terrace Length

For level terraces of given dimensions, the length shall be held within reason so that damage, in case of a break, shall be minimized. Terrace segment length shall not exceed 3,500 feet. Terrace blocks with an effective height approximately two-thirds the height of the terrace may be used to obtain the above maximum lengths.

In general, graded terrace lengths will normally be controlled by capacity and the nonerosive velocity requirement.

*Outlets

Terraces shall not outlet on the right-of-way of a public road, highway, utility, or other landowner without approval of proper authorities and/or affected landowner. State laws governing the disposal of water shall be adhered to.

Soil infiltration may be used as an outlet to remove water from level terraces. Infiltration rates must remove the design storm within 48 hours from the terrace channel so crops are not significantly damaged by water. To determine if the terrace will have adequate infiltration use the following: North Dakota Irrigation Guide, Chapter 2; County Soil Survey Report; and SCS Soil Form 5, Soils Interpretation Period found in Technical Guide Section II-G. Care shall be taken in areas of salinity so the problem will not be compounded with level terraces.

*Safety and Maintenance

Terraces are considered to be nonfunctional when any of the following exists:

1. The existing Resource Management System has soil loss in excess of "T" and the Terrace System has a spacing wider than allowed by current criteria.

2. The existing cross-sectional area for storage is less than 50 percent of the storage area at design height of this standard.

3. The system needs updating to be more farmable.

Supporting data shall be prepared that clearly shows the system is or is not functional in accordance with the above criteria. Restored terraces shall be designed in accordance with this standard.

*Vegetation

Chiseling, topsoil spreading, manure application, and fertilizing should be considered on all disturbed areas to bring cropland into high production as soon as possible.

*Plans and Specifications

It is recommended that three sets of plans and specifications are provided if the terrace system warrants it (i.e. complex layout or major underground outlet system). Two sets are for the cooperator and one set is for the NRCS files. The cooperator shall provide a set to the contractor.

It is recommended that a contractual agreement be entered into between the contractor and cooperator for completion of work.

The following are guidelines for terrace construction (terrace check out):

Terrace ridge:	Design grade to 0.3 foot high
Terrace channel:	0.1 foot high to 0.2 foot low
Channel width:	Design width +10% not to exceed +2 feet.

Deviations from these guidelines shall require justification.

*Terrace Specifications

The moisture content of the fill material should be such that when kneaded in the hand, the soil forms a ball which does not readily separate. Cuts and fills shall be made in such a manner that topography will be enhanced. Excessive cuts shall not be made in depressions to secure borrow to build the terrace ridge through these areas, since this accentuates the undulations of the field. Borrow for large fills across depressions shall be taken from the intervening ridges, preferably immediately below the terrace ridge, which will tend to flatten the area to be farmed.

Conduits shall be bedded and backfilled throughout the base width of the terrace ridge. Friable soil material shall be placed in 6 inch layers and hand tamped to a depth of approximately 18 inches. The sides of the trench shall be sloped no steeper than 3 to 1, with backfill placed in 6 inch layers and machine compacted. The materials used for the inlet and conduit shall meet the requirements of Underground Outlet (620) and Subsurface Drain (606). Terrace ridges constructed across gullies or depressions shall be compacted by machinery travel or by other suitable means to insure proper functioning of the terrace.

Grassed backslope terraces shall have the entire backslope seeded. Narrow base terraces shall have both the backslope and the frontslope seeded.

Planning considerations for water quantity and quality

Quantity

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

2. Variability effects caused by seasonal or climatic changes.

3. The type of outlet, time of water detention, topography, and geology of the site.

4. Effects of snow catch and melt on water budget components.

5. Potential for a change in plant growth and transpiration because of changes in the volume of soil water.

6. Effects on the downstream flows or aquifers that could affect other water uses and users.

7. The effect on the water table suitable rooting depth for anticipated land uses.

8. Potential for water management to supply alternate uses.

Quality

1. Effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that would be carried by runoff.

2. Effects of nutrients and pesticides on surface and ground water quality.

3. Effects on the visual quality of onsite and downstream water.

4. Short-term and construction-related effects on the quality of onsite and downstream water.

5. Potential for development of saline seeps or other salinity problems resulting from increased infiltration in soils that have restrictive layers.

6. Potential for uncovering or redistributing toxic materials such as saline soils.

7. Effects on the movement of dissolved substances below the root zone and to the ground water.

8. Effects on wetlands and water related wildlife habitats.